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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/995,421	11/27/2001	Won-Young Chung	5649-909	1882

20792 7590 04/19/2007
MYERS BIGEL SIBLEY & SAJOVEC
PO BOX 37428
RALEIGH, NC 27627

EXAMINER	
GEBRESILASSIE, KIBROM K	
ART UNIT	PAPER NUMBER
2128	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	04/19/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	09/995,421	CHUNG ET AL.	
	Examiner	Art Unit	
	Kibrom K. Gebresilassie	2128	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *14 February 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3-10,12-19,21-28 and 30-35* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1, 3-10, 12-19, 21-28, and 30-35* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. This communication is responsive to amended application filed on February 14, 2007.

2. Claims 1, 3-10, 12-19, 21-28, and 30-35 are pending.

3. Claims 1, 10, 19, 28, 30, 32, and 34 are amended.

4. Claims 2, 11, and 20 are canceled.

Response to Arguments

5. Response to 102 rejection: Applicant's arguments with respect to claims have been considered but are moot in view of the new ground(s) of rejection.

6. Response to 103 rejection: No argument were presented for 103(a) rejection and therefore the rejection maintained.

Drawings

7. Fig. 2, Fig. 3, and Fig. 5 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawings in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 112

8. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

9. Claims 1, 10, 19, 28, and 32 are rejected under 35 U.S.C. 112, second paragraph, as being incomplete for omitting essential steps, such omission amounting to a gap between the steps. See MPEP § 2172.01. The omitted steps are: the claimed inventions are not used to achieve what the application recited in the preamble. (estimating characteristics of plasma) M.D.

10. Claims 1, 10, and 19 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The claimed invention recites " a plurality of magnets move with respect to the reaction chamber." Examiner is not clear whether the magnets rotating around the chamber or rotating in place.

11. All dependent claims depend on rejected independent claims are also rejected because they depend on a rejected claims.

Claim Rejections - 35 USC § 101

12. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

13. Claim 19, and 21-27 are rejected under 35 U.S.C. 101 as being directed to nonstatutory subject matter since the claims as a whole are drawn to computer code *per se* and do not provide for a practical application, as evidenced by lack of physical transformation or a useful, tangible, and concrete result.

Claim Rejections - 35 USC § 103

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

15. Claims 1, 3, 5-10, 12, 14-19, 21, 23-28, 30-32, and 34-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over W. Y. Chung, J. J. Oh, T. K. Kim, J. K. Shin, K. Seo, Y. K. Park, and J. T. Kong, "Integrated Simulation of Equipment and Topography for Plasma Etching in the DRM Reactor," 2000 IEEE, Herein referred as **Chung,** in view of J. P. Yonnet, and A. Picard, "Permanent Magnet Configuration for Magnetic-Field-Enhanced RIE," IEEE 1990, herein referred as **Yonnet**.

As per Claim 1:

Chung discloses a method of estimating characteristics of a plasma contained in a reaction chamber of a plasma reactor including a plurality of magnets that move with respect to the reaction chamber (such as... "...the magnetic fields arising from the rotating magnets." Page 127, Right side column, lines 3-7), the method comprising:

obtaining configuration and process condition data for the reaction chamber (such as... "profiles in terms of the equipment operating parameters such as the gas composition ratio and power." Abstract; Fig. 1, Step one);

computing plasma characteristics for each of a plurality of cross-sections of the reaction chamber from the configuration and process condition data (such as... "The plasma parameters are computed at several 2-dimensional cross-sections with a distinctive magnetic field distribution...." (See: Page 128, left side column, lines 1-3)); and

generating a generalize model of the plasma from the computed plasma characteristics for the plurality of cross-sections (such as... "...and overall etching characteristics are obtained by averaging over these several 2-D calculations." (See: page 128, left side column, line 3)).

Chung discloses a plurality of magnets that rotates around the reaction chamber (**See: Introduction)**. However, Chung fails expressly to disclose wherein the plurality of moving magnets rotate about an axis of rotation, and wherein each of the plurality of cross-sections includes the axis of rotation.

Yonnet discloses wherein the plurality of moving magnets rotate about an axis of rotation, and wherein each of the plurality of cross-sections includes the axis of rotation (**See: Fig. 7-Fig. 12; "IV. Rotating Magnet Systems" of page 291**).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine the teachings of Yonnet et al with Chung et al because both references are clearly concerned with Reactive Ion Etching. The motivation for doing so would have been convenient to have a plurality of moving magnets rotate about an axis of rotation, as taught by Yonnet et al, for simulation system of Chung et al to increase the itching speed of the RIE and to obtain uniform itching rate (See: Yonnet et al, Abstract and Conclusion).

As per Claim 2:

Canceled.

As per Claim 3 (Original):

Chung discloses a method according to Claim 1, wherein computing plasma characteristics for each of a plurality of cross-sections of the reaction chamber comprises performing the following actions for each of the cross-sections:

computing electron density and temperature for the cross-section using an iterative Monte Carlo computational procedure (such as...***the energy and angular distributions of all particles striking the wafer are obtained using Monte Carlo Simulation***...;**See: Page 128, left side column, lines 10-12**); and

computing ion and neutral species transmission phenomena for the cross-section from a plasma dynamics simulation (such as ...***Ion Angular Distribution, Ion Energy Distribution in Kinetic Simulation***; **See: Fig. 1 Step 4**).

As per Claim 5 (Original):

Chung discloses determining a static magnetic field generated by the moving magnets (such as ...***the magnetic fields arising from the rotating magnets***...;**See: Page 127, Right side column, lines 3-7**), and wherein computing plasma characteristics for each of a plurality of cross-

sections of the reaction chamber comprises computing the plasma characteristics for each of the plurality of cross-sections from the determined static magnetic field, shape information for the reaction chamber, and plasma collision reaction data (such as...***The plasma parameters are computed at several 2-dimensional cross-sections with a distinctive magnetic field distribution....*;See: Page 128, left side column, lines 1-3**).

As per Claim 6 (Original):

Chung discloses generating a generalized model of the plasma from the computed plasma characteristics for the plurality of cross-sections comprises computing at least one of an electron density distribution, a temperature distribution, a distribution of ion species, a distribution of neutral species, and a flux incidence (such as...***Ion, Radical Fluxes, E-field Density, Ion Angular Distribution, Ion Energy Distribution...*; See: Fig. 1 and Fig. 4**).

As per Claim 7 (Original):

Chung discloses generating a generalized model of the plasma from the computed plasma characteristics for the plurality of cross-sections comprises averaging the computed plasma characteristics for each of the plurality of cross-sections (such as***...and overall etching characteristics are obtained by averaging over these several 2-D calculations...*;See: page 128, left side column, line 3**).

As per Claim 8 (Original):

Chung discloses estimating an etching rate for a wafer positioned in the chamber from the generalized model of the plasma (such as ***...the uniformity of the etch rate and profile evolution are obtained in terms of plasma process conditions....*;See: Page 128, left side column, Second Paragraph**).

As per Claim 9 (Original):

Chung discloses the plasma reactor comprises a dipole ring magnet (DRM) plasma reactor (such as ***DRM Reactor;* See: Abstract**).

As per claim 11:

Canceled.

As per claim 20:

Canceled.

As per Claim 28 (Currently Amended):

Chung discloses a method of simulating plasma in a plasma apparatus having a plasma reactor and a plurality of paramagnet magnets which are asymmetrically arranged and rotate around plasma reactor at predetermined speed, comprising the steps of:

(a) inputting shape and process conditions (such as...***profiles in terms of the equipment operating parameters such as the gas composition ratio and power....***;**See: Abstract; Fig. 1, Step one**) and inputting plasma collision reaction data (such as... "contact profile"; Abstract);

(b) 3-dimensionally computing static magnetic fields induced by the permanent magnets (such as...***the magnetic field induced by complex permanent magnets of the DRM equipment are 3-dimensionally computed using a commercial software, VectorFields...***; **See: Page 127, right side column, Under a title "The Simulation Flow and Etch Model"; Fig. 1 Step two**);

(c) computing electron density and temperature and interpreting the transmission phenomenon of ion and neutral species using the data of the steps (a) and (b) until they are converged (such as...***good agreement of the calculated and measured values and distribution...***; **See: Page 127, right side column, Under a title "The Simulation Flow and Etch Model"**);

(d) obtaining overall plasma characteristics using the converged values (such as...***and overall etching characteristics are obtained...***;**See: Page 128, left side column, line 3**); and

wherein the step(c) comprises plasma simulation at 2-dimensional cross-sections for cross-sectional magnetic field distribution in a characteristics magnetic field direction (such as...***based on VectorFields to accurately take account the magnetic fields arising from the rotating magnets....***;**See: page 127, right side column, lines 4-8**).

Chung discloses wherein the 2-dimensional plasma simulation is performed for a plurality of 2-dimensional cross-sections (**See: Page 128, left side column ,first and second paragraph**). However, Chung fails expressly to disclose wherein the 2-dimensional plasma simulation is performed for a plurality of 2-dimensional cross-sections **including an axis**.

Yonnet discloses wherein the 2-dimensional plasma simulation is performed for a plurality of 2-dimensional cross-sections **including an axis** (**See: Fig. 7-Fig. 12; "IV. Rotating Magnet Systems" of page 291**).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine the teachings of Yonnet et al with Chung et al because both references are clearly concerned with Reactive Ion Etching. The motivation for doing so would have been convenient to have a plurality of moving magnets rotate about an axis of rotation, as taught by Yonnet et al, for simulation system of Chung et al to increase the itching speed of the RIE and to obtain uniform itching rate (See: Yonnet et al, Abstract and Conclusion).

As per Claim 29

Canceled.

As per Claim 30 (Currently Amended):

Chung discloses 2-dimensional plasma simulation obtains convergence values for the respective cross-sections, and averages them to obtain plasma characteristics (such as...***and overall etching characteristics are obtained by averaging over these several 2-D calculations...*;See: page 128, left side column, line 3**).

As per Claim 33 (Canceled):

As per claims 10, 12, 14-19, 21, 23-27, 31, 32, 34, and 35:

The limitations of claims 10, 12, 14-19, 21, 23-27, 32, 34, and 35 have already been discussed in the rejection of claims 1, 3, 5-9, 28, 30, and 31. The instant claims is/are functionally equivalent to the above rejected claims and is/are therefore rejected under the same rationale.

16. Claims 4, 13, and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over W. Y. Chung, J. J. Oh, T. K. Kim, J. K. Shin, K. Seo, Y. K. Park, and J. T. Kong, "Integrated Simulation of Equipment and Topography for Plasma Etching in the DRM Reactor," 2000 IEEE, Herein referred as **Chung**, as applied to claims 1, 3, 5-10, 12, 14-19, 21, 23-28, 30-32, and 34-35 above, and further in view of P.L.G. Ventzek, R. J. Hoekstra, and M. J. Kushner, "Two-dimensional modeling of high plasma density inductively coupled sources for materials processing," 1994 American Vacuum Society, herein referred as **Ventzek**.

As per Claim 4 (Original):

Although, Chung discloses the ion and neutral species transmission phenomena for the cross-section from a plasma dynamics simulation such as obtaining ion angular distribution, ion energy distribution in kinetic simulation using a Monte Carlo simulation (See: Fig. 1 Step 4).

Chung fails expressly to disclose computing solutions to a continuity equation and Poisson's equation for the ion and neutral species.

Ventzek discloses computing solutions to a continuity equation and Poisson's equation for the ion and neutral species such as solving the continuity equations and Poisson's equation for all charges and neutral species in Fluid Chemical Kinetic Simulation (See: Page 464, Right side column, lines 9-11 and Equation 12 and Equation 13).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine the teachings of Ventzek et al with Chung et al because both references are clearly concerned with etching process of semiconductor materials. The motivation for doing so would have been more convenient to solve the Poisson's equation for a future time using a prediction for the charge densities based on the present values of their time derivatives to overcome the limitation imposed by dielectric relaxation time (See: Page 465, left side column, lines 27-31).

As per Claims 13 and 22 (Original):

The limitations of claims 13, and 22 have already been discussed in the rejection of claim 4. The instant claims is/are functionally equivalent to the above rejected claims and is/are therefore rejected under the same rationale.

Conclusion

17. Claims 1, 3-10, 12-19, 21-28, and 30-35 are rejected.

18. Examiner's Note: Examiner has cited particular columns and line numbers in the references applied to the claims above for the convenience of the applicant. Although the specified citations are representative of the teachings of the art and are applied to specific limitations within the individual claim, other passages and figures may apply as well. It is respectfully requested from the applicant in preparing responses, to fully consider the references in their entirety as potentially teaching all or part of the claimed invention, as well as the context of the passage as taught by the prior art or disclosed by the Examiner.

19. In the case of amending the claimed invention, Applicant is respectfully requested to indicate the portion(s) of the specification which dictate(s) the structure relied on for proper interpretation and also to verify and ascertain the metes and bounds of the claimed invention.

Communications

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kibrom K. Gebresilassie whose telephone number is 571-272-8571. The examiner can normally be reached on 8:00 am - 4:30 pm Monday to Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kamini S. Shah can be reached on 571-272-2279. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

KKG

HUGH JONES Ph.D.
PRIMARY PATENT EXAMINER
TECHNOLOGY CENTER 2100